

AD-A273 472**IDENTIFICATION PAGE**

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1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED ANNUAL - 1 Jun 89 - 31 Dec 90
4. TITLE AND SUBTITLE CRUSTAL DEFORMATION MEASUREMENTS IN THE VICINITY OF VANDENBERG AIR FORCE BASE	5. FUNDING NUMBERS AFOSR-89-0400 61102F 2309 AS	
6. AUTHOR(S) Dr Robert W. King	7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Earth Atmospheric & Planetary Sciences Massachusetts Institute of Technology Cambridge MA 02139 AFOSR-JR-	
8. PERFORMING ORGANIZATION REPORT NUMBER	9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFOSR/NL 110 Duncan Avenue, Suite B115 Bolling AFB DC 20332-0001 Dr Dickinson	
10. SPONSORING/MONITORING AGENCY REPORT NUMBER	11. SUPPLEMENTARY NOTES	
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited	12b. DISTRIBUTION CODE A	

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DEC 07 1993

13. ABSTRACT (Maximum 200 words)

Recent geological and geodetic studies have suggested that the region surrounding Vandenberg AFB, CA is undergoing active crustal deformation. In 1989 funding under this grant was used to purchase five GPS receivers and to begin a series of measurements designed to determine the magnitude and spatial distribution of deformation in a region encompassing the major faults and folds within 50 km of Vandenberg. Four receivers were acquired in January 1990 and experiments were performed in February and September. The fifth receiver will be sited near the former NASA Very Long Baseline site and will become integrated into the Permanent GPS Geodetic Array in California.

14. SUBJECT TERMS			15. NUMBER OF PAGES
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT (U)	18. SECURITY CLASSIFICATION OF THIS PAGE (U)	19. SECURITY CLASSIFICATION OF ABSTRACT (U)	20. LIMITATION OF ABSTRACT (UL)

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Crustal Deformation Measurements in the Vicinity of Vandenberg Air Force Base

Grant AFOSR-89-0400
(MIT OSP No. 72373)

Annual Technical Report
for the period

1 June 1989 - 31 December 1990

Submitted to

Air Force Office of Scientific Research

James F. Lewkowicz
Program Manager
PL/LWH Hanscom AFB MA 01731-5000

Capt Helen R. Tyson
Contracting Officer
AFOSR/PKZA
Bolling AFB, DC 20332-6448

by

Robert W. King
Principal Investigator
Department of Earth, Atmospheric, and Planetary Sciences
Massachusetts Institute of Technology
Cambridge, MA 02139

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30 September 1991

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BACKGROUND AND OBJECTIVES

Recent geological and geodetic studies have suggested that the region surrounding Vandenberg AFB is undergoing active crustal deformation, with important implications for both the geodetic stability and the seismogenic potential of the Western Test Range (WTR). We have described these studies in a paper (Feigl *et al.*, 1990) published in the *Journal of Geophysical Research* and attached to this Interim Report. Part of the evidence for significant deformation was obtained from GPS measurements which we carried out in cooperation with other university and government scientists beginning in late 1986. These measurements have been made annually over a broad region of central and southern California but are of insufficient spatial and temporal density to answer many important questions about the seismogenic potential of Vandenberg.

In 1989 we received funding under this grant (with matching funds from MIT) to purchase five GPS receivers and to begin a series of measurements designed to determine the magnitude and spatial distribution of deformation in a region encompassing the major faults and folds within 50 km of Vandenberg. We acquired four of the receivers in January 1990 and carried out two-week experiments in February and September. The fifth receiver is to be installed and operated continuously at the site of a new, highly stable geodetic monument near the former NASA VLBI site on south base. It will become part of the Permanent GPS Geodetic Array (PGGA) in California, providing a stronger tie of Vandenberg to the regional VLBI and GPS network and also a potential opportunity to detect any small transient motion which might occur at Vandenberg.

MEASUREMENTS PERFORMED IN 1990

The stations occupied in our experiments of February and September, 1990, are shown in Figure 1. The first of these experiments was designed to test our new receivers, to remeasure four sites (VNDN, LOSP, GRAS, and GAVI) first observed in 1987 and 1989, and to add three additional sites (ALAM, ALVA, and RUS1) to the network. Measurements to ALVA and RUS1, both within 5 km of the Vandenberg VLBI site, should detect any seaward sliding of the alluvium underlying the VLBI site. During the September experiment we reoccupied all eight of the previously established sites in the network and added one additional site (LIND) in a region where it had been difficult to find a monument which is in stable terrain and not close to radio antennas that might interfere with GPS observations.

DEVELOPMENT OF THE PGGA STATION

Between late 1989 and early 1991 we carried out an extensive series of discussions with responsible officials at Vandenberg concerning the siting and installation of the Permanent GPS Geodetic Array (PGGA) station on south base. It is important that the site be 1) geologically stable, 2) close to existing power and communications lines, 3) free from obstructions and radio-frequency interference, 4) not in an area where its installation would have an adverse environmental impact. In October 1989 we met on base with SAC and WTR officials responsible for radio-frequency control, civil engineering, and environmental affairs, and with representatives from NASA and the DMA Geodetic Survey Group, our primary liason for GPS work. At the same time we conducted a reconnaissance survey of four possible sites. This meeting and survey narrowed our choice to the vicinity of the VLBI site, and in January 1990 we submitted a formal request through USAF channels for an upgrade of the VLBI facility to include the new GPS station. Our original choice of a site was found to be in an area known to have archeological artifacts, so we shifted our interest to a new area several hundred meters away. In order to assess the geological stability of the new area, in September 1990 we supervised the drilling of five test holes from which we have now selected a site for the station. In 1991 we plan to construct at the site a high-stability geodetic monument of the type designed by Dr. Frank Wyatt of Scripps for the other stations of the PGGA. In order to take advantage of forthcoming improvements in GPS receiver design, we have delayed our purchase of a receiver for the PGGA station until the new models are available. These models promise higher efficiency in the measurements, probably at lower cost.

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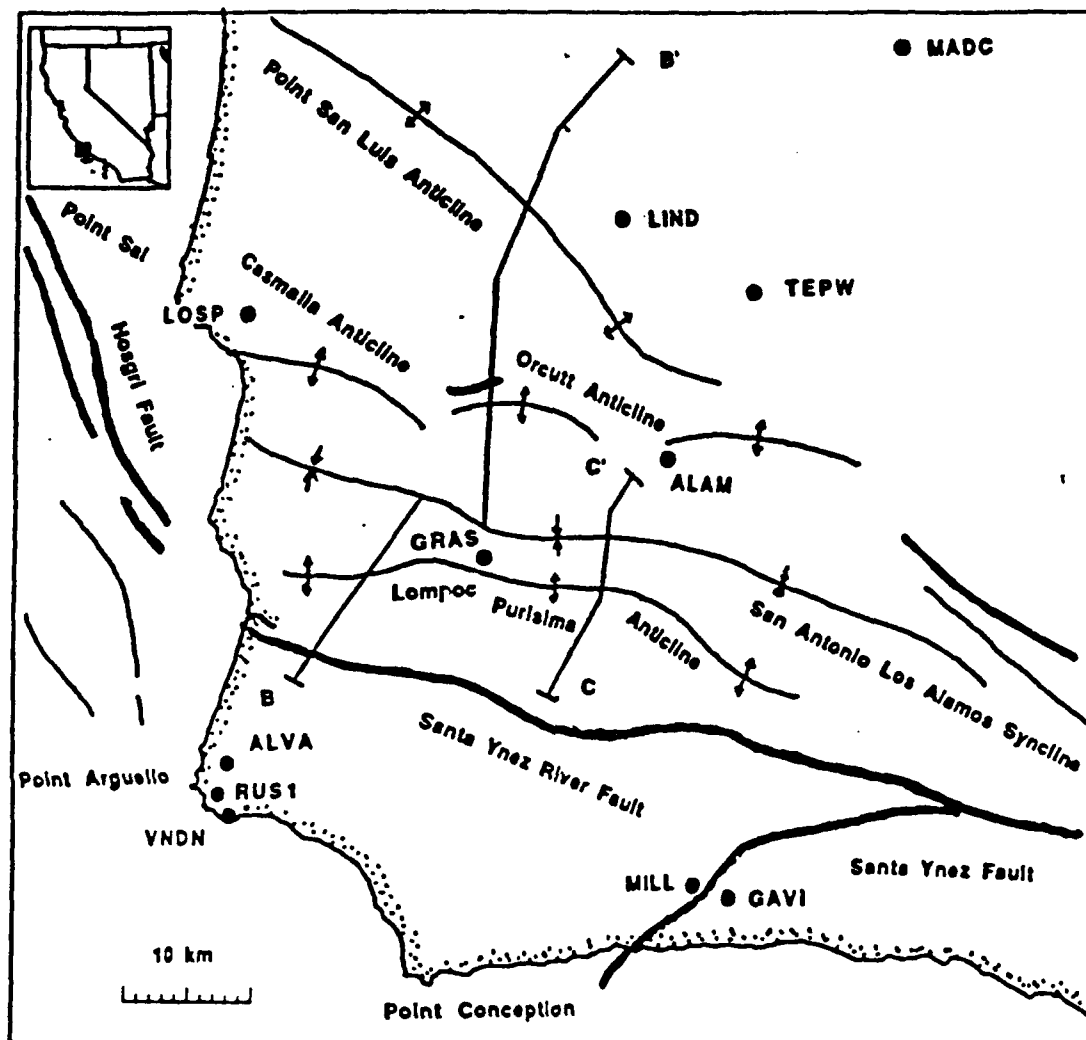


Figure 1. Tectonic map of Vandenberg and vicinity (Santa Maria Fold and Thrust Belt) showing the location of faults (thick lines) and folds (thin lines) and of the GPS stations (black dots with 4-letter codes) included in our study.